Illinois Natural History Survey

Section of Faunistic Surveys & Insect Identification

Urbana, Illinois

December 29, 1954 Identification Notes 1

Corn flea beetles and their allies

Milton W. Sanderson

In the Mississippi Valley about fifteen species of flea beetles have been found associated with corn or have been taken commonly on vegetation in corn fields or along field margins. Only three or four of these species are believed to be of importance on corn, the others feeding occasionally if at all on this plant. Several of these species are superficially similar. The following key is designed to distinguish between species of little concern and those of economic importance.

Key to Genera or Species

1. Dorsum with short erect hairs; body usually black but some species reddish or pale. . . . . *Epitrix*

   Dorsum without hairs. 2

2. Each elytron having a longitudinal yellowish stripe 3

   Elytra uniformly dark or pale 4

3. Elytral stripe nearly even in width throughout most of its length (fig. 1) . . . . . *Systena blanda*

   Elytral stripe irregular in width (fig. 2) . . *Phyllotreta*

4. Elytral punctures uniformly distributed, not arranged in rows; color usually dull yellow . . . . . Longitarsus

Elytral punctures in distinct rows (fig. 3) 5

5. Antenna 10-segmented . . . . . Psylliodes

Antenna 11-segmented 6

6. Posterior tibia with a conspicuous broad two-pointed apical spur (fig. 4) . . . . . Dibolia

Posterior tibia without or with an inconspicuous single-pointed apical spur (fig. 5) 7

7. Color yellowish 8

Color black 9

8. Pronotum having a transverse basal impression . . . . Crepidodera

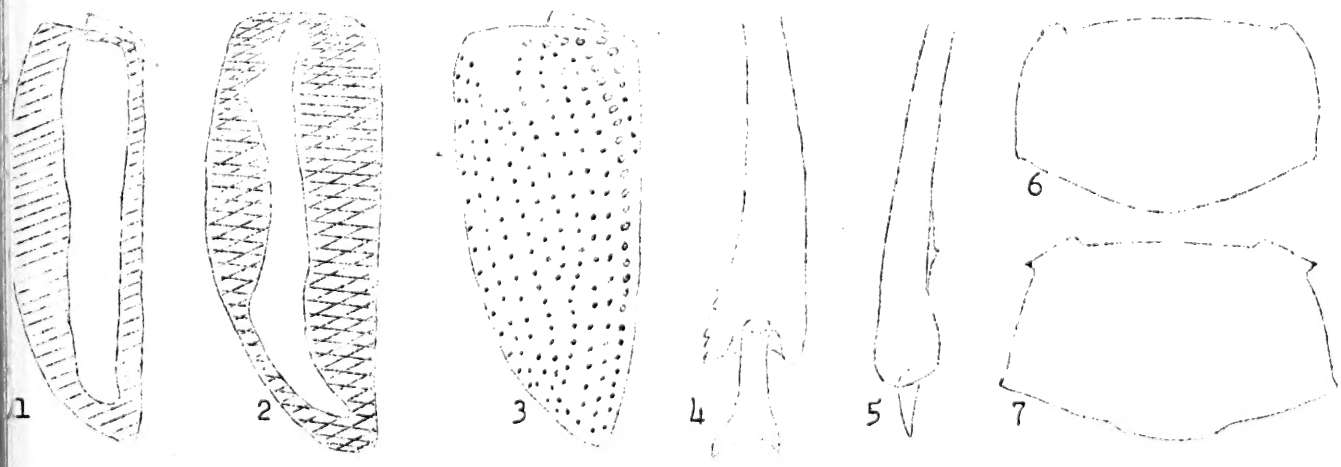
Pronotum without a basal impression . . . . . Glyptina brunnea

9. Body robust, 2 to 2.5 mm. long . . . . . Chaetocnema denticulata

Body less robust, 1-1.5 mm. long 10

10. Last 8-9 antennal segments dark brown to black; side margin of pronotum evenly rounded near anterior angle (fig. 6) . . . . . Chaetocnema pulicaria

Antenna uniformly yellowish ; side margin of pronotum oblique and toothed behind anterior angle (fig. 7) . . . . . Chaetocnema confinis



Flea beetles frequently found on corn

Chaetocnema pulicaria Melsh. - Corn flea beetle.

This small black beetle is at most about 1/17 inch in length, and is primarily responsible for flea beetle leaf injury to corn and for transmitting Stewart's disease of corn. It is closely similar to confinis, the sweet potato flea beetle, but in pulicaria the antenna is dark, the lateral margin of the pronotum is rounded to the anterior angle, and the pronotum is extremely finely and closely punctured and rather dull in appearance. The corn flea beetle is generally distributed throughout the corn belt and over the eastern United States. It feeds on many species of grasses and sedges, and has been found active from April to November. It overwinters as an adult.

Chaetocnema denticulata Illig. - Toothed flea beetle.

This flea beetle may be nearly twice the size of the corn flea beetle. It is capable of transmitting Stewart's disease but is unimportant in this role. Generally it occurs on corn in much smaller numbers than the corn flea beetle but appears to prefer several native grasses which are hosts also for the corn flea beetle. It is generally distributed over the eastern United States.

Chaetocnema confinis Crotch - Sweetpotato flea beetle

The sweetpotato flea beetle is of the same size and appearance as the corn flea beetle and has been confused with it. Its presence in corn fields is doubtless due to the presence of its native hosts which are various species of the morning glory family (Convolvulus and Ipomoea). It probably causes no injury to corn but it has successfully transmitted Stewart's disease under laboratory conditions. It overwinters as an

adult and is active for about the same period of the year as the corn flea beetle. It may be distinguished from the corn flea beetle by its yellowish instead of dark antenna, presence of a slight tooth near the anterior margin of the pronotum, and the larger and more widely separated pronotal punctures, with the surface of the pronotum more shining.

Systena blanda Melsh. Pale striped flea beetle.

The pale striped flea beetle probably is most injurious to corn during the larval stage, but the adults have been recorded as having caused considerable damage (Forbes). It is widely distributed over the United States, and feeds on a variety of both wild and cultivated hosts. It is about twice the length of the corn flea beetle.

Miscellaneous flea beetles

Most of the genera or species included in the key rarely are found on corn but feed on various plants, other than grasses, morning glory and bindweeds, in or adjacent to cornfields. Some of these hosts are: Epitrix on the nightshade family (Solanaceae), Psylliodes and Phyllotreta on the mustard family (Cruciferae), Dibolia on plantain (Plantago), Glyptina on Phyla lanceolata in the verbena family, Longitarsus on several families of plants, and Crepidodera on Phyla and Acalypha in the verbena and spurge families, respectively.

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Illinois Natural History Survey

Section of Faunistic Surveys & Insect Identification

Urbana, Illinois

March 15, 1955 Identification Notes 2

Important Illinois Spittlebugs

Thomas E. Moore

All five genera of United States spittlebugs occur in Illinois, represented by eighteen species. Many of these species are important as plant disease vectors and agents of reduction of plant vitality. Adults are mainly responsible for disease transmission, but both adults and nymphs can cause great damage through feeding. All spittlebug nymphs produce frothy enclosures of "spittle" from their anal excretion composed of plant juices mixed with certain digestive, glandular, and excretory products. The nymphs live in their spittle masses and seldom emerge until adulthood, with the exception of the species that regularly leave the spittle to moult. Adults of the spittlebug family, or Cercopidae, may be distinguished from other families of the needle-horned series of the Homoptera by the presence of (1) two large lateral spines on each hind tibia (rather than rows of spines as in leafhoppers), and (2) setae situated just below the tip on these spines and those of the apical crown, figs. 2, 4. Nymphs of this family may be recognized by (1) association with spittle, and (2) having setae situated just below the tips of the spines of the apical crown on each hind tibia, figs. 13, 14.

Illustrations, labeled to show generic affinities, are drawn from specimens of the species mentioned in the text. The following keys will aid in the recognition of economically important species.

Key to Genera (adults and nymphs)

1. Fore wing longer than half the length of abdomen, some veins raised above wing surface; antenna comprised of three segments and an arista, figs. 10, 20, 23 . . . . . Adults . 2

   Fore wing pad, when present, less than half as long as abdomen, no veins raised above surface of wing pad; antenna of seven to nine segments, arista not present, figs. 17, 18 . . . . . Nymphs . 6

Adults

2. Fore wing with a well developed membrane at apex, fig. 1; hind tibia with a single series of apical spines, fig. 2 . . . . . <u>Clastoptera</u>

Fore wing having only a very narrow membranous margin, fig. 3; hind tibia with two or more series of apical spines, fig. 4 3

3. Lateral margin of pronotum much longer than length of eye, greatest width of pronotum at least one-third more than that of head across eyes, fig. 5 . . . . . Tomaspis

Lateral margin of pronotum shorter than length of eye, greatest width of pronotum never more than slightly exceeding that of head across eyes, fig. 6 . . . 4

4. Beak extending to hind coxae, its apical segment at least half again as long as the preapical one, fig. 7 . . . . . Aphrophora

Beak not reaching hind coxae, its apical segment much less than half again as long as the preapical one, figs. 8, 9 5

5. Ridge overhanging antenna on upper front margin of head double, with a shallow groove between ridges, fig. 10 . . . . . Philaenus

Ridge overhanging antenna on upper front margin of head single, groove not present . . . . Lepyronia

Nymphs

6. Hind tibia with one series of apical spines, fig. 13. . . . . Clastoptera

Hind tibia with at least two series of apical spines, fig. 14 7

7. Apical segment of beak at least half again as long as preapical one, fig. 16 . . . . . Aphrophora

Apical segment of beak much less than half again as long as preapical one, fig. 15 8

8. Third antennal segment at least half again as long as fourth, fig. 17 . . . . . Tomaspis

Third antennal segment less than half again as long as fourth, fig. 18 9

9. Subanal plate of abdomen having posterior projections which are relatively narrow and sharp, figs. 21, 22; late last instar nymphs with third segment of adult antenna formed beneath nymphal cuticle with sensory setae arranged around arista as in fig. 23. . . . . Philaenus

Subanal plate having posterior projections which are more broadly rounded, fig. 19; late last instar nymphs with third segment of adult antenna formed beneath nymphal cuticle with sensory setae arranged around arista as in fig. 20 . . . . . .Lepyronia

Important Illinois Species

Aphrophora parallela Say - pine spittlebug

The presence of a pair of prominent, parallel dark stripes on a light background on the scutellum will separate adults of this species from those of the saratoga spittlebug which have a more or less uniformly light or dark colored scutellum. Nymphs are easily distinguished since they occur on pines, while those of the saratoga spittlebug occur on ferns and other low vegetation, but not on pines. The pine spittlebug inserts its eggs into the bark of branchlets, while the saratoga spittlebug lays its eggs between the bracts of terminal leaf buds or sheaths of the seasons needles.

First signs of feeding damage caused by the pine spittlebug are usually the sudden turning reddish-orange needles of scattered twigs, mainly in lower branches. A. parallela has been associated with the spread of Scotch Pine blight fungus.

Aphrophora saratogensis Fitch - saratoga spittlebug

This is the only other spittlebug recorded from pine in Illinois and is the more common species here. Its stages may be distinguished from those of the pine spittlebug by means of characters listed in the preceeding discussion. The illustrations for Aphrophora are drawn from specimens of this species.

Pines primarily infested by the saratoga spittlebug show characteristic early signs of damage in the flagging of small branchlets and later of terminals of tops and laterals. The dying parts first turn a yellow-green color, then straw-color, and finally reddish. This species is associated with the spread of a fungus, Chilonectria cucurbitula, infecting damaged pines.

Clastoptera achatina Germar - pecan spittlebug

The pecan spittlebug may be readily recognized since it is the only Illinois species known to occur in large numbers on pecan. It is the only spittlebug for which two generations per growing season are known in Illinois. The eggs are inserted in rows into bark of pecan twigs. Nymphs occur mainly on terminals and young nuts, those of the first generation usually appearing about June 1 with those of the second generally hatching about July 10. Adults are often collected on other plants, but may be recognized from other species of this genus by their possession of a uniformly light yellow dorsum of the head, pronotum, and scutellum. Closely related species in this area have one

or more transverse bands of darker color on the dorsal surface of the head and pronotum, and usually have contrasting colors on the scutellum.

Damage most evident from the feeding of this species is the die-off of fruit-producing terminals. This reduction of potential yield may average as high as eighty-seven percent in some orchards at times of high spittlebug populations.

Lepyronia quadrangularis Say

This is primarily a woods and woods' edge species whose nymphs develop on grasses, poison ivy, and other low growing vegetation. Sometimes nymphs of this species and those of the meadow spittlebug occur together in orchard or field border - wood's edge situations. These nymphs sometimes can be distinguished very readily from those of Philaenus leucopthalmus, since they often have the posterior part of the head and the upper part of the thorax and wing pads darkened in the nymphal cuticle. Such cuticle coloration is unknown for the meadow spittlebug.

Philaenus leucopthalmus Linnaeus - meadow spittlebug

This is by far the most commonly encountered spittlebug in the state, having relatively recently established itself as a pest on many small grain and forage crops in practically every area in Illinois. Specimens of spittlebug mymphs collected from fields of these crops are almost invariably meadow spittlebugs. This species, is a rather general feeder which can mature, sometimes in pest proportions, on numerous other plant hosts. It has been recorded as a pest on orchard plantings, roses, strawberries, and in greenhouses.

Eggs are laid between leaf sheaths near the soil in September and October, pass the winter, and hatch in early April. There are either four or five nymphal instars, with adults appearing in early May and remaining active until frost. Adults of the meadow spittlebug are quite variable in coloration. They may be distinguished from other Illinois species in this genus by their possession of a large, median, oval dark spot on the mesosternum.

Feeding is generally confined to more succulent, newer growth resulting in such symptoms as reduced plant vitality, reduced seed or hay production, stunted growth, shortened internodes, and rosetting. The meadow spittlebug is a proven vector of Pierce's disease of grapevines and alfalfa, of peach yellows, and of alfalfa dwarf, all virus diseases.

Tomaspis bicincta Say

There are two color forms of this large species both of which occur in Illinois. The northern one is very dark brown or black while the southern form is brown with two or three transverse reddish or yellowish bands on the upper surface. Nymphs have been collected on grasses of the genus Digitaria. Adults are recorded as feeding, sometimes in pest proportions, on grasses, holly, and sweet corn. The species is only locally abundant in Illinois

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Explanation of Figures

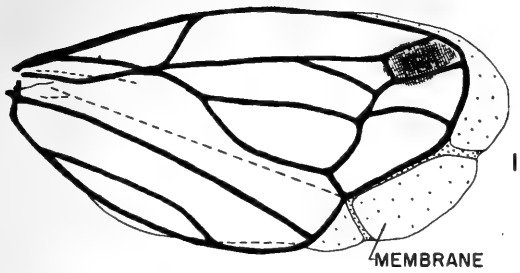
Plate 1 (adults)

Fig. 1 - Fore wing of Clastoptera achatina
Fig. 2 - Hind tibia of C. achatina
Fig. 3 - Fore wing of Philaenus leucopthalmus
Fig. 4 - Hind tibia of P. leucopthalmus
Fig. 5 - Dorsal outline of head and prothorax of Tomaspis bicincta
Fig. 6 - Dorsal outline of head and prothorax of Lepyronia quadrangularis
Fig. 7 - Beak (labium) of Aphrophora saratogensis
Fig. 8 - Beak of Lepyronia quadrangularis
Fig. 9 - Beak of Philaenus leucopthalmus
Fig. 10 - Lateral aspect of head of P. leucopthalmus
Fig. 11 - Dorsal outline of P. leucopthalmus, P - pronotum, S - scutellum
Fig. 12 - Dorsal outline of Clastoptera achatina, P - pronotum, S-scutellum

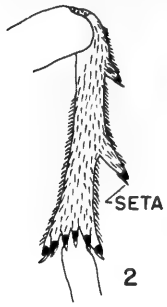
Plate 2 (nymphs)

Fig. 13 - Hind tibia of Clastoptera achatina
Fig. 14 - Hind tibia of Philaenus leucopthalmus
Fig. 15 - Beak (labium) of P. leucopthalmus
Fig. 16 - Beak of Aphrophora saratogensis
Fig. 17 - Antenna of Tomaspis bicincta
Fig. 18 - Antenna of Philaenus leucopthalmus
Fig. 19 - Subanal plate of Lepyronia quadrangularis
Fig. 20 - Adult antennal segments of L. quadrangularis, arista incomplete
Fig. 21 - Ventral aspect of abdominal segments 3 to 9 of Philaenus leucopthalmus showing subanal plate
Fig. 22 - Subanal plate of P. leucopthalmus
Fig. 23 - Adult antennal segments of P. leucopthalmus, arista incomplete

PLATE I



CLASTOPTERA



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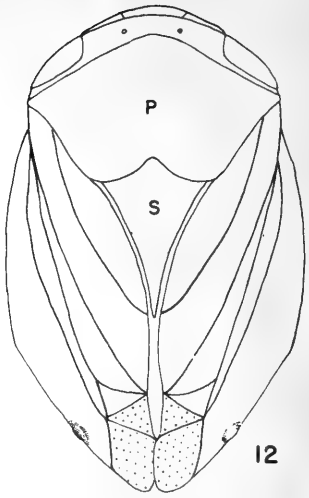

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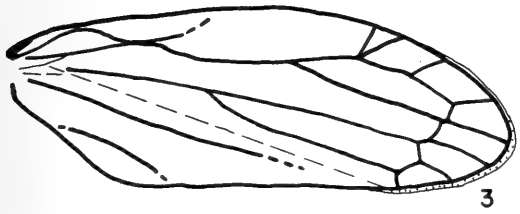
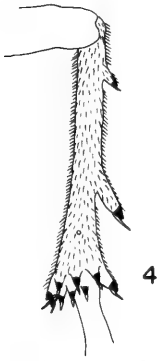


PHILAENUS



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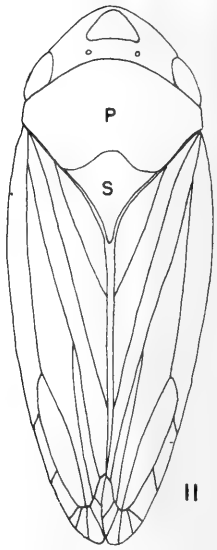

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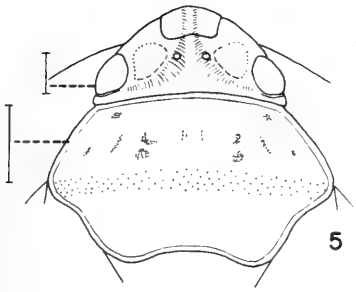

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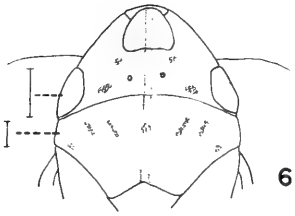
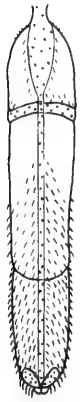


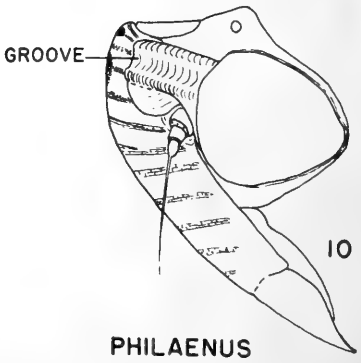
LEPYRONIA

APHROPHORA



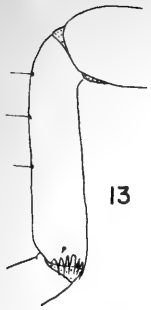
LEPYRONIA

PHILAENUS

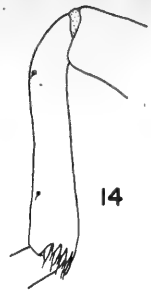


PHILAENUS

PLATE 2



CLASTOPTERA



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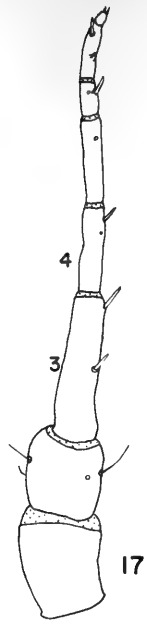

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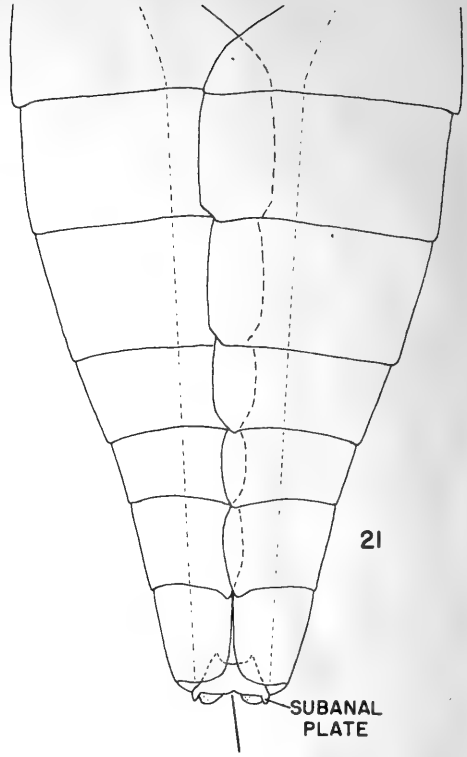

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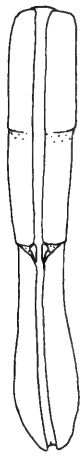
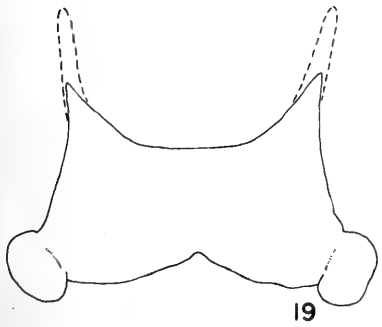


APHROPHORA



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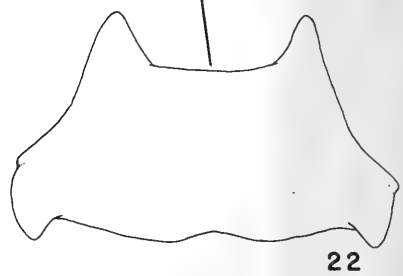

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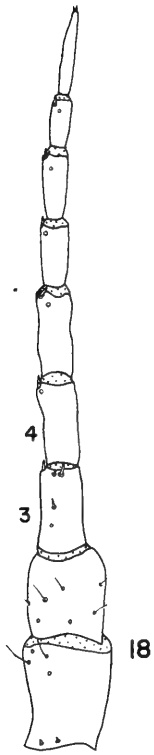

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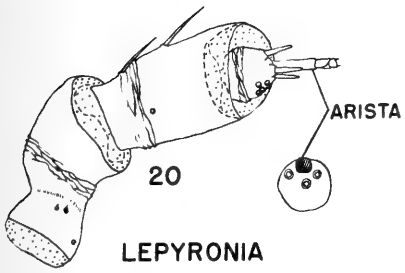

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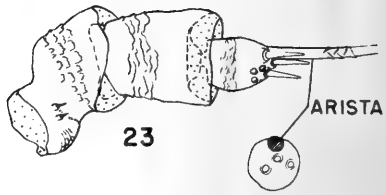

PHILAENUS

Illinois Natural History Survey

Section of Faunistic Surveys & Insect Identification

Urbana, Illinois

March 17, 1955 Identification Notes 3

Ticks of Importance in Illinois

Lewis J. Stannard, Jr.

Ten species of ticks are known to occur in Illinois. Another half dozen more species eventually may be found, either occasionally from shipments of livestock or from resident species of mammals and birds. Of the common Illinois ticks, two are dangerous as the proven vectors of diseases often fatal to man, and several more are suspected to be vectors of these and other diseases.

Ticks belong to the large group that includes spiders, scorpions, and mites. This group of animals, in the adult stage, always possesses four pairs of legs. By contrast insects, which are distant relatives of ticks, have only three pairs of legs when fully grown. Unlike spiders and scorpions, ticks have no external division between the abdomen and the anterior part of the body that bears the legs. From most mites, ticks differ in being larger and in being covered by a hard, tough epidermis. Usually they are so tough that it is impossible to crush them between one's fingers.

In their development from egg to adult, ticks pass through several distinct stages. From the egg, there issues a larva which has only three pairs of legs. This larva feeds on blood, grows, and molts into the nymph, which, like the adult, has four pairs of legs. Nymphs feed and transform into adults, in which stage the genital opening appears, usually situated between the first two pairs of coxae. Ticks of the family Argasidae lay only a few eggs at a time and have two nymphal stages. Ticks of the family Ixodidae lay their eggs in large masses and have only one nymphal stage.

Structures used in the following key and discussion are:

Capitulum: the movable front part of the body on which is situated the mouth parts. The base of the capitulum, fig. 1, BC, lies behind the mouth parts and its shape is of use for determining species.

Palpi: the paired, outer, segmented appendages of the mouth parts. Seen from above only segments II and III are visible, fig. 1. Segments I and IV are small and lie underneath.

Eyes: when present, a pair of eyes, each composed of a single lens, is borne on the sides of the tick body, fig. 1. In preserved specimens the eyes sometimes become so transparent they are difficult to detect.

Coxa: the first segment of each leg, that is, the segment which attaches the leg to the body. The coxae often bear spurs, figs. 2 and 3.

Key to Illinois Ticks of Economic Importance

(Larvae, which have only three pairs of legs, are not included.)

1. Body leathery and warty; mouth parts attached to the undersurface of the tick ..... Family ARGASIDAE, 2

   Body hard, finely wrinkled but not warty; mouth parts attached to the front margin of the tick ..... Family IXODIDAE, 3

2. Upper and lower surfaces of body separated along the sides by a fine, continuous, sunken line; front margin of the tick evenly rounded ..... adults and nymphs of Argas persicus

   Upper and lower surfaces of body not separated along the sides by a fine continuous, sunken line; front margin of the tick with a distinct, hood-like extension .... adults and nymphs of Ornithodoros kelleyi

3. Fore coxa with two large, equally long, closely joined spurs, fig. 2 4

   Fore coxa with or without spurs, if with spurs these are widely spaced and, at the most, only one of them is long, fig. 3 ... 6

4. Body without any silver-colored markings; base of capitulum (BC) hexagonal in outline, similar to fig. 4 .... adults of Rhipicephalus sanguineus

   Body with silver-colored streaks either near the front part of the tick or over the entire upper surface; base of capitulum (BC) rectangular in outline, fig. 1 5

5. Found feeding in fall and winter on large domestic or wild animals, not on man or dogs ..... adults of Dermacentor albipictus

   Found feeding in spring and summer on large and small animals, frequently on man and dogs .. adults of Dermacentor variabilis

6. Palpi short, segments II and III (PII & PIII) each ringed by a sharply protruding ridge, fig. 4 .... adults and nymphs of Boophilus annulatus

   Palpi generally longer, segments II and III both not ringed by a prominent ridge 7

7. Base of palpal segment II drawn out to an angle at the outer sides, fig. 5 .. adults and nymphs of Haemaphysalis leporis-palustris

Base of palpal segment II not drawn out to an angle at the outer sides 8

8. Base of capitulum (BC) sharply pointed, figs. 6,7 9

Base of capitulum (BC) not produced into a sharp point, figs. 1, 5 10

9. Base of capitulum (BC) nearly triangular; palps more slender, fig. 7 ..... nymphs of Dermacentor variabilis

Base of capitulum (BC) hexagonal in outline; palps stouter, fig. 6 ..... nymphs of Rhipicephalus sanguineus

10. Upper surface of body with a bright silver-colored spot or spots ..... adults of Amblyomma americanum

Body without silver-colored markings 11

11. Without eyes ..... adults and nymphs of Ixodes

With eyes 12

12. Shield containing eyes wider than long .... nymphs of Amblyomma americanum

Shield containing eyes longer than wide .... nymphs of Dermacentor albipictus

Family ARGASIDAE

Leathery, warty ticks with each spircaular plate located forward of the hind coxa, and with the mouth parts attached on the under surface.

Argas persicus (Oken)
Fowl tick

This argasid tick has not been found as yet in Illinois but may be expected in shipments of chickens from the South. It feeds principally on domestic fowl, which, as a result, may become weakened and die.

Ornithodoros kelleyi Cooley and Kohls
Kelly's bat tick

This is the only warty tick likely to be encountered in houses in Illinois. It feeds exclusively on bats and, as far as is known, will not attack human beings or their pet mammals or birds. These ticks may be expected occasionally in houses which harbor bats in the attic or in the walls.

Family IXODIDAE

Hard ticks without warts but often with punctures or fine fingerprint-like lines, with each spiracular plate located behind the hind coxa, and with the mouth parts attached to the forward part of the body, visible from above, fig. 1.

Amblyomma americanum (Linnaeus)
Lone star tick

As yet this species has not been found in Illinois, but it may eventually be discovered in the southern part of the state since it occurs in neighboring Missouri and in Tennessee. Females have a conspicuous silver-colored spot towards the middle of the upper surface of the body; males bear several silver-colored streaks scattered over the upper surface.

The lone star tick has been recorded as feeding on cattle, horses, many other animals, even birds, and on man and dogs. According to Dr. Bequaert (1946), it was the first tick from the United States to be mentioned in print (1739).

Boophilus annulatus (Say)
Cattle tick

Years ago a number of specimens of this tick were collected from cattle near Bloomington, Illinois. Since then none has been found in our state. Formerly it was widely distributed in the southern part of our country, but rigorous control measures have brought it to near extinction in the United States. The species still exists in Mexico and possibly also in Puerto Rico, and is introduced occasionally from these areas in continental United States. The cattle tick is the carrier of an organism which produces the destructive Texas cattle fever.

Dermacentor albipictus (Packard)
Winter tick, moose tick

The winter tick is known in Illinois from a number of localities in the central and northern half of the state. So far all specimens were collected from cattle in November and December. Since most of our records are from imported animals it is probable that albipictus is not now a native Illinois tick but that it is periodically introduced. There are reports that this tick can cause serious losses to cattle and horses. Its wild hosts probably are moose, elk (wapiti) and deer.

Dermacentor albipictus differs from its relative D. variabilis in being a one host tick, that is, its entire development from larva to adult takes place on one individual mammal. The monograph of the genus Dermacentor by Cooley (1938) discusses structural characteristics by which variabilis may be separated from albipictus and other related species. Since some of these characteristics are subject to variation or require detailed study, it is advisable to consult this monograph or a named collection when differentiating these species on a morphological basis alone. For practical purposes, the identification of variabilis and albipictus in Illinois can be reliably determined solely on the time of year of their occurrence as indicated in the key.

Dermacentor variabilis (Say)
American dog tick, variable wood tick

From the human viewpoint, this is the most dangerous tick in Illinois. It is common throughout the state and frequently attacks man and dogs. It can and often does carry the organism which produces Rocky Mountain spotted fever. The Illinois Department of Public Health has reported a total of 209 cases and 24 deaths of Rocky Mountain spotted fever in Illinois during a recent 10 year period.

As a precaution, those who expect to be around bushy places during the spring and early summer should receive a specific vaccine from their physician to guard against this fever. In addition it is advisable to look oneself over for ticks upon returning from the out-of-doors. Often these ticks wander for hours before biting and it is usually possible to remove them before any harm is done.

Unlike D. albipictus, variabilis is a three host tick, that is, in its development it leaves its host between each stage from larva to adult and seeks a new host for each subsequent feeding.

Haemaphysalis leporis-palustris (Packard)
The continental rabbit tick

Although this tick never bites man, it is the chief transmitter of the tularemia organism to wild rabbits and thereby is indirectly a serious pest to human beings, especially hunters. It feeds mostly on rabbits but occasionally also on song birds. In mid-winter in Illinois this tick goes into hibernation at which time rabbits are entirely free of the tick and of tularemia. Most cases of tularemia are fatal to rabbits. Man contracts the disease from sick rabbits and not actually from ticks that might be still on the rabbit's pelt.

Rhipicephalus sanguineus (Latreille)
Brown dog tick

Essentially the brown dog tick is a tropical species which is able to survive here only because our houses are constantly warm throughout the winter.

Dogs pick up these ticks from other dogs, from houses, or from kennels, rarely if ever from the wild. It hardly ever bites man. In Illinois it is not known to transmit any disease-producing organism.

Ixodes ticks

The species listed below have been found in Illinois. Except for one species rare in our area, Ixodes scapularis, they seldom bite human beings under normal circumstances. Ticks of this genus never have eyes nor silver-colored markings.

Ixodes cookei Packard - on various mammals
Ixodes dentatus Marx - on rabbits
Ixodes muris Bishopp and Smith - mostly on mice
Ixodes scapularis Say - on many mammals and birds
Ixodes sculptus Neumann - mostly on ground squirrels

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Explanation of Figures

abbreviations: BC - base of capitulum; P - palpus

Fig. 1 - Dorsal aspect of *Dermacentor variabilis*, female

Fig. 2 - fore coxa of *Dermacentor variabilis*, female

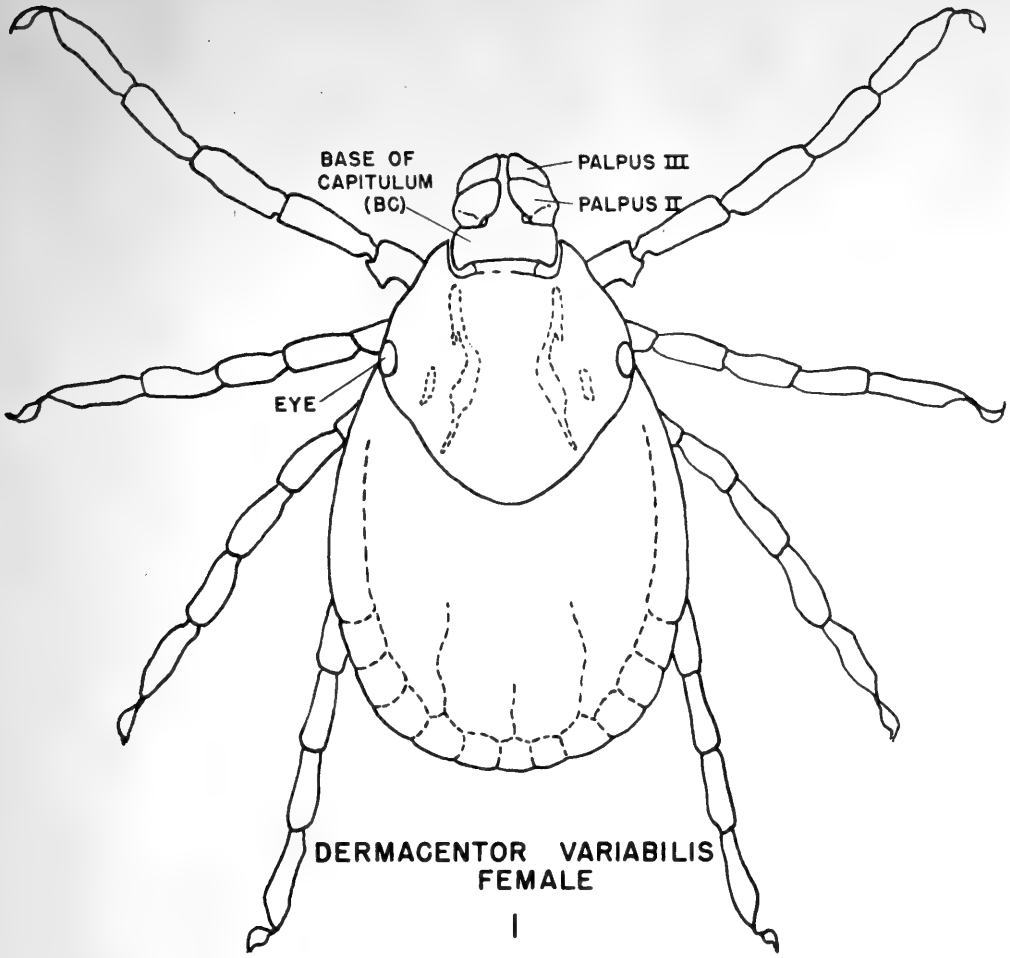
Fig. 3 - fore coxa of *Amblyomma americanum*, female

Fig. 4 - capitulum of *Boophilus annulatus*, female

Fig. 5 - capitulum of *Haemaphysalus leporis-palustris*, female

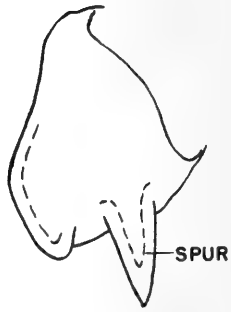
Fig. 6 - capitulum of *Rhipicephalus sanguineus*, nymph

Fig. 7 - capitulum of *Dermacentor variabilis*, nymph



DERMACENTOR VARIABILIS
FEMALE
1

2
DERMACENTOR
ADULT



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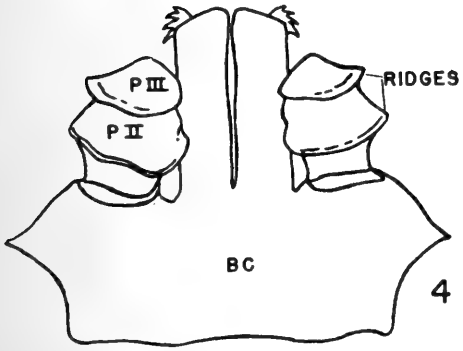
AMBLYOMMA



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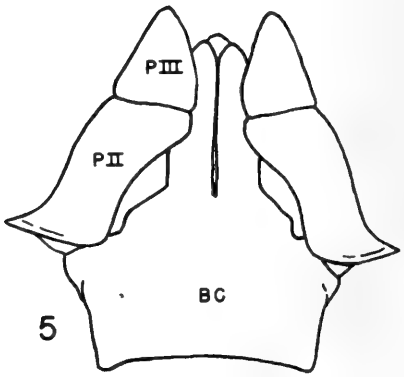
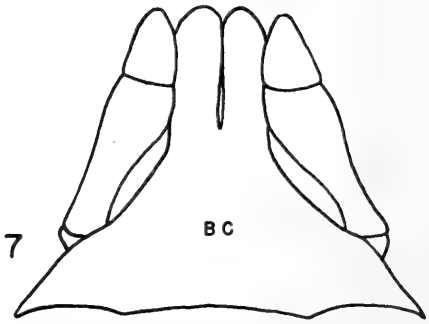
BOOPHILUS



5
HAEMAPHYSALIS

6
RHIPICEPHALUS



7
DERMACENTOR VARIABILIS

Nat. Hist. Survey ~~Prepublication~~

ILLINOIS NATURAL HISTORY SURVEY

SECTION OF FAUNISTIC SURVEYS AND INSECT IDENTIFICATION

Urbana, Illinois June 1, 1962

A SELECTED BIBLIOGRAPHY OF INSECT-VASCULAR PLANT ASSOCIATIONS IN THE UNITED STATES AND CANADA

BY

MILTON W. SANDERSON

AND

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Identification note no. 4

F-4

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INTRODUCTION

Despite the tremendous economic losses caused by phytophagous insects and the vital importance of insect-plant relationships to agricultural sciences, nowhere in the North American literature is there a comprehensive compilation by plant families of principal works that treat insect associates of single species or genera of vascular plants. Our efforts to find reliable plant host association information for several beetle families disclosed this lack of available bibliographies as well as some inconsistencies in the method of reporting plant-insect relationships.

In the course of studies in our individual specialties, we have found many references that provided us with useful information and ideas. We have compiled them in this report under various categories, believing that they will quickly provide for others an initial source for which we originally searched. Undoubtedly this compilation will aid others in locating references which we have missed. It is our hope that it will stimulate the unearthing of unpublished theses on the subject, and that it will focus attention not only on the work that has already been accomplished, but also on areas that are in need of exploration.

As we arranged references in order by plant families, we became aware that there exist many families and genera for which no studies have been published on the plant-insect relationships. Certainly these families and omitted genera would be fruitful areas of investigation for a master's or doctoral thesis.

In our scrutiny of the literature, we were constantly confronted with inconsistencies in the methods of reporting host data, and uncertainties in reporting the degree of association of the insect with its host plant. We feel that the ideal report should state as fully as possible the relationships of each insect species in all of its stages with each stage of the plant species. It should also recognize that insect associations range from that of simply a resting site to one in which the insect is an obligatory associate of a single plant species. Many so-called "host records" signify only that the insect was collected on the plant, and may or may not indicate an actual breeding association. However, indefinite records of this nature should not be hastily discarded until the status of the association can be ascertained because such records may offer the only clues to the true relationships between the organisms.

The importance of accurate identification of plant species or smaller units is obvious when it is recognized that generalizations concerning insect-host relationships should be based on precise identification. Generic identifications of plants often are insufficient. Likewise, the investigator should work with the smallest taxonomic unit possible in the insects. Associations, if they are to have validity in the future, may require that documented inflorescent bearing plant samples with associated insects be permanently preserved for future reference should taxonomic refinements or misidentifications suggest restudy.

We found no reports which possessed all of the ideal characteristics although some approached closely (Balduf, 1959; Judd, 1961). Many reports gave only a list of the insects that had been collected on the plant and omitted any explanation of their true relationships, while others gave the life histories of a few insects with a list of other insects taken on the plant.

An excellent example of a desired type of study is the report by Judd (1961) in which he correlates the occurrence of insects during the growth of skunk cabbage (Symplocarpus foetidus). This paper demonstrates that knowledge of the mechanisms by which insects are attracted to plants, or are held there, is an essential and intimate component of one's understanding of the plant-insect relationships.

Several basic botanical references for the area covered which we found useful are:

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The compilation is limited to vascular plants, including the pteridophytes. Except as noted, each original paper was examined to check the accuracy of the citation and to determine content suitability. Generally, references to vertebrate and non-insect assemblages were omitted except as they were included in the general plant and insect association. The authors strongly suggest that for the convenience of cataloging, the specific Latin names should be included in the title of the paper. The present paper comprises four sections, each having a specific purpose.

ACKNOWLEDGMENTS

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Section I is the main body of references to insect assemblages with a plant species or genus, arranged in alphabetical order by plant family and by plant genus or species. We have attempted to limit our bibliography in this section to several categories: (1) references to reports of associations from a single locality, (2) reports which cover the entire range of the plant, (3) native plants in or out of cultivation, (4) uncultivated introduced plants which attract our native insects, and (5) some introduced plants in cultivation. References were omitted which treated only injurious insects of a specific introduced plant unless this was the only treatment available for that plant. Other references were omitted which were concerned primarily with identification and control of insects associated with specific cultivated plants. Whenever we experienced doubt regarding the applicability of some references, we included them. Special attention is directed to the work of Kaltenbach (1874) cited in Section II. This work is arranged by plant families, and although restricted to European insects, it has one of the most complete listings of plant-feeding insects that we have seen. It may offer clues to the food habits of the American members of insect genera common to both continents.

Section II is a special section devoted to the principal works of Charles Robertson. Both botanist and entomologist, he wrote prolifically between 1886 and 1933 on the subject of interrelations of insects and flowers. His Flowers and Insects (1929), arranged in alphabetical order by plant families, summarized

his personal observations between 1899 and 1929, and his principal earlier references were included. Section I would have been unduly enlarged had we included the Robertson references under each plant family, thus our decision to give these references a special category. Many other references of Robertson not included here treat phenology, evolution of entomophilus flowers, and anthecology. They can be found in Ecology, Scientific Monthly, Psyche, and the American Naturalist.

Section III contains a list of general references to phytophagous insects. Some individual reports contain many sections treating specific plant-insect associations such as the work by Packard (1890) on shade tree insects, Craighead (1950) on eastern forests, and the companion work by Keen (1958) on western forests. Others are valuable sources of more general associational data involving plant associes such as prairies (Hendrickson, 1930, 1931; Vestal, 1913), hammocks (Dozier, 1920), and swamps. The works of Brues (1946) and Frost (1959) are basic works including general treatments of phytophagous insects, and they contain extensive bibliographies.

Section IV includes principal references to the phytophagous food habits of several insect orders. Peterson's excellent manuals of insect larval forms (1948, 1951) include extensive food plant lists of the insect orders treated. The list of references under this section is by no means complete, but it will give the worker a basis for further bibliographical searching, especially at the insect family level.

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